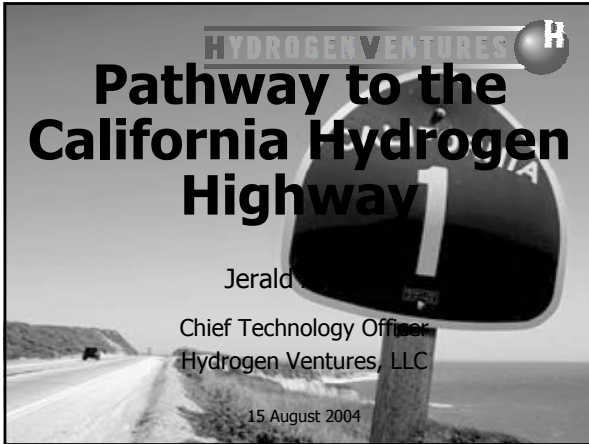
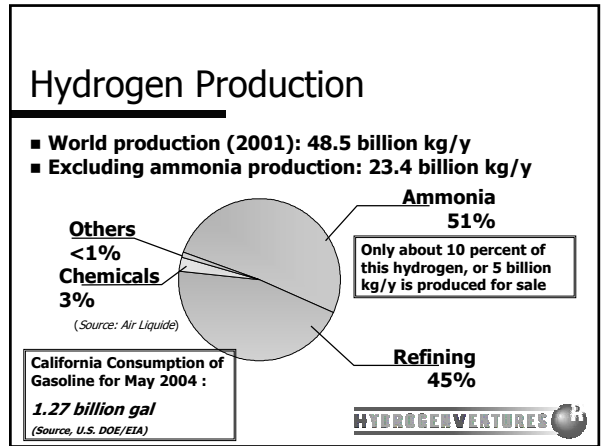


HYDROGEN VENTURES

Pathway to the California Hydrogen Highway

Jerald ...
Chief Technology Officer
Hydrogen Ventures, LLC

15 August 2004

Hydrogen Production

- Bottom Line**
 - Total U.S. Production of Merchant Hydrogen is about half of world production
 - Equivalent to two-months worth of gasoline consumed in California today

Critical Issue of Concern:
Where will the hydrogen come from?

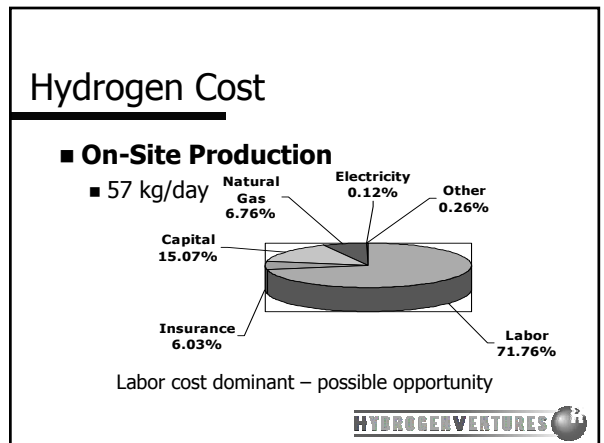
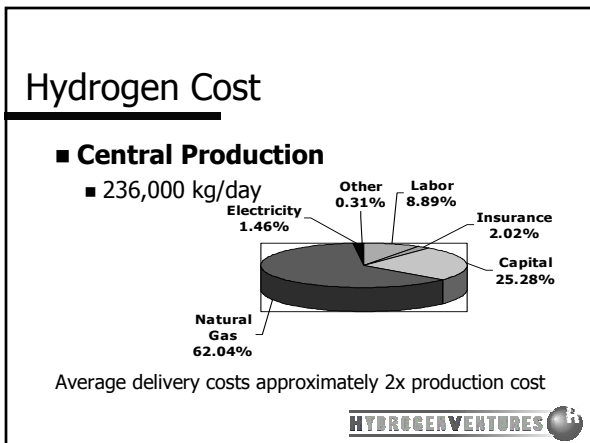
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Hydrogen Cost

- Large-Scale Central Production**
 - Typically about \$0.85 – \$1.10/kg
- On-Site Production**
 - Estimated at \$5.10 - \$6.00/kg
- Renewable Hydrogen (Biological)**
 - \$13.53/kg (NREL Estimate)

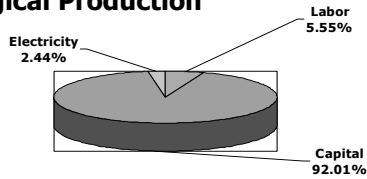
Delivery Costs easily \$1.70/kg

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Hydrogen Cost

■ Biological Production



New paradigm for production cost estimates



Safety Concerns

• The Zeppelin *The Hindenburg*

- Contained 7 million cu. ft. of hydrogen
- Burned and crashed in Lakehurst NJ on 6 May 1937
- 62 survivors
- 35 dead
 - One was burned
 - 34 jumped or fell



Recommendations

- Disabuse the public about what they "know"
- Business needs to evaluate the costs in terms of "future" alternatives
- Industry must look at new ways to improve the cost equation



Path Forward

- Hydrogen Production
 - Requires new infrastructure
- Cost Issues
 - Rethinking our values?
- Safety Issues
 - Need more experience – NASCAR?

